Decision Memo for Intestinal and Multivisceral Transplantation (CAG-00036N)

Decision Summary

In summary, Medicare will cover intestinal transplantation for the purpose of restoring intestinal function in patients with irreversible intestinal failure only when performed for patients who have failed TPN and only when performed in centers that meet approval criteria. The criteria for approval of centers will be based on an annual volume of 10 intestinal transplants per year with a 1-year actuarial survival of 65 percent.

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Decision Memo

To: File: Intestinal and Multivisceral Transplantation
CAG-00036N

From:

Sean R. Tunis, M.D., M.Sc.
Director, Coverage and Analysis Group

Jackie Sheridan
Technical Advisor, Coverage and Analysis Group

Kenneth Simon, M.D.
Medical Officer, Coverage and Analysis Group

Jennifer Doherty
Health Insurance Specialist, Coverage and Analysis Group

Re: National Coverage Policy Request on Intestinal Transplantation

Date: October 4, 2000

This memorandum serves four purposes: (1) it describes small bowel and multivisceral transplantation as treatment for intestinal failure; (2) it outlines current coverage policy for organ transplantation; (3) it analyzes relevant clinical literature; and (4) it delineates Medicare's response to this request for a national coverage policy.

Description and Background of Small Bowel and Multivisceral Transplantation

Small bowel transplantation (SBT) is the transplantation of a cadaveric intestinal allograft for the purpose of restoring intestinal function in patients with irreversible intestinal failure. SBT can be performed in isolation, in combination with transplantation of liver (for patients who have liver failure, which often occurs in children on long-term total parenteral nutrition (TPN)). In addition to intestinal failure, candidates for multivisceral transplantation (MVT) have developed evidence of impending liver failure and other gastrointestinal problems such as pancreatic failure, thromboses of the celiac axis and the superior mesenteric artery, or pseudo-obstruction affecting the entire gastrointestinal tract.

Intestinal failure is defined as the loss of absorptive capacity of the small bowel secondary to severe primary gastrointestinal disease or surgically induced short bowel syndrome. The major causes of intestinal failure are volvulus, gastroschisis, necrotizing enterocolitis, splanchnic vascular thrombosis, inflammatory bowel disease, radiation enteritis, congenital diseases and trauma. Intestinal failure prevents oral nutrition and may be associated with both mortality and profound morbidity.

Most of the non-transplant surgical options for intestinal failure (e.g., bowel lengthening) have been unsuccessful in improving absorptive capacity of residual bowel, and none are regarded as sufficiently safe and effective for routine use.[1] Total parenteral nutrition (TPN) delivers nutrients intravenously, avoiding the need for absorption through the small bowel. The majority of patients are managed on TPN.

Intestinal transplantation in humans proved clinically feasible in the late 1980's. Most of the literature acknowledges that the procedure is effective, but has considerable morbidity and mortality. Rejection episodes for intestinal transplantation are relatively frequent. For example, acute rejection for patients who were transplanted through February 1997 is reported in 79 percent of SBT, 71 percent of SB/LT and 56 percent of MVT. [2] Moreover, several patients developed lymphoproliferative disease and serious infections, such as cytomegalovirus. About half of the patients receiving intestinal transplants survive for 5 years or more.

Current Medicare Policy Related to Organ Transplantation

Medicare coverage of kidney transplantation was enacted by law in 1976. Kidney transplants may only be furnished in centers that meet specific criteria that are delineated in regulation (42 CFR part 405, subpart U). Coverage for other types of organ transplants was implemented administratively under the national coverage process.

Medicare extended coverage to heart transplants in 1987, but only in facilities that met criteria outlined in the *Federal Register* (52 FR 10935). Liver transplantation, for certain specified diagnoses, first became effective in 1992 (56 FR 15006) in facilities that meet specified criteria. The indications for liver transplantation were expanded in 1996 and 1999, and presently include all patients with end stage liver disease except those with malignancies. Medicare national coverage policy for lung transplantation became effective in February 1995 (60 FR 6537) for facilities that meet specified criteria. Coverage for pancreas transplantation first occurred in July 1999.

Medicare has established minimum 1- and 2-year actuarial survival standards for heart, liver and lung transplant centers. In order to be approved for Medicare coverage, a facility must demonstrate that its actuarial survival is equivalent to or exceeds these standards. The Medicare 1-year actuarial survival standards for heart, liver and lung facilities are 73%, 77%, and 69%, respectively. Two-year actuarial survival standards are 65%, 60% and 62%, respectively.

There is currently no national Medicare coverage policy on intestinal transplantation. In the absence of national coverage policy, Medicare contractors are charged with the responsibility for making individual determinations regarding whether a particular service can be considered reasonable and necessary under section 1862(a)(1)(A) of the Social Security Act. To the best of our knowledge, all Medicare contractors are presently denying coverage for intestinal transplants.

Analysis of Relevant Clinical Literature

In its deliberation on the initial formal request, HCFA considered various sources. First, we considered the information submitted by the requestor, which included 11 distinct studies. Secondly, we reviewed the July 1999 technology assessment that was performed by the Blue Cross Blue Shield Association's Technology Evaluation Center. Thirdly, we requested the Center for Practice and Technology Assessment at the Agency for HealthCare Research and Quality to perform a separate technology assessment on this subject. This was completed in April 2000.

1. Literature Submitted by Requestor

All of the 11 articles submitted with the original request were case reports or case series. Three of the articles included only one or two cases and represented early (pre-1991) experiences with the procedure. Four of the articles included the results of only pediatric patients (three reports of children under 10 years and one on children less than 18 years). We note, however, that the evidence indicates significant differences in outcomes between pediatric and adult populations, with outcomes of intestinal transplantation best in the pediatric population. Five of the 11 articles submitted by the requester included adult patients.

Three of the non-pediatric case series included progressively longer periods of case analysis at a single health care provider (i.e., results of cases from 1990 - 1995, cases from 1990 - 1996, and cases from 1990 - 1997 at University of Pittsburgh Medical Center). Consequently, the patients in these reports were duplicated. For purposes of this memorandum, we will discuss only the most recent of these articles, a similar analysis of the cumulative experiences at another facility (University of Miami), and an analysis of the intestinal transplant registry.

The article "Clinical Intestinal Transplantation: New Perspectives and Immunologic Considerations" discusses the experiences of 98 consecutive patients, both adult and children receiving intestinal transplants for a range of indications[3]. Thirty-seven received small bowel transplants alone, 50 received small bowel and liver transplants, and 17 received multivisceral transplants. Actuarial patient survival at 1-year was 72% and 5-year survival was 48%. One-year graft survival was 64% and 5-year graft survival 40%. The differences among the three types of transplants were not significant.

The primary causes of death in these patients were rejection, infection, technical and management errors and B-cell lymphoma. The use of donor bone marrow at time of transplant was not found to significantly influence rejection episodes. Ninety-one percent of the surviving patients attained full nutritional autonomy. The article states that "the morbidity and mortality is still too high for their [intestinal transplants] widespread application."

The article "Clinical Intestinal Transplantation: Experience in Miami"[4] describes the results of 19 intestinal transplants performed at the University of Miami from August 1994 through July 1996. The cases included all three intestinal transplant types for both adults and children. Median length of follow-up was 106 days. Eleven of the 19 patients survived through the follow-up period, but actuarial survival was not included in the study. Seven of the patients had survived longer than 365 days and all patient deaths occurred within the first 76 days following surgery.

David Grant, et al. reported on cumulative intestinal transplantation in an article entitled "Intestinal Transplantation: 1997 Report on the International Registry".[5] This article included data on 272 transplants in 269 patients from 33 intestinal transplant programs. Two-thirds of the recipients were children. Short gut syndrome was the most common indication for transplantation. Forty-one percent of the procedures were for small bowel transplants alone, 48% for small bowel and liver, and 11% for multivisceral grafts. One-year patient survival for transplants performed after February 1995 was 69% for small bowel alone, 66% for small bowel and liver transplants, and 63% for multivisceral. Transplants since 1991 and programs that had performed at least 10 transplants had significantly higher graft survival rates. Seventy-seven percent of the current survivors had stopped total parenteral nutrition and resumed oral nutrition. There was no association between type of donor, donor pretreatment or diagnosis and graft or patient survival. Although most intestinal transplants arise from cadaveric donors, nine patients received grafts from living donors with comparable results to cadaveric transplants (67% survival).

According to David Grant, because most children and adults function well on TPN, the risks of intestinal transplantation are only warranted when standard therapies have failed. He states that patients who can be maintained on long-term TPN are generally not considered for transplantation at this time. He recommends an isolated small bowel graft when patients develop 1) fluid and electrolyte losses that cannot be managed with TPN, 2) severely limited venous access, and/or 3) moderate liver dysfunction secondary to TPN. Combined small bowel/liver transplants are offered to patients with 1) irreversible liver failure due to TPN, or 2) intestinal failure associated with a hypercoagulable state that can be corrected by a simultaneous liver graft. Multivisceral transplants are offered to patients with locally aggressive tumors that can only be removed by a massive evisceration of the abdominal organs.

2. Blue Cross Blue Shield Technology Evaluation Center Assessment

Blue Cross Blue Shield Technology Evaluation Center (TEC) reviews technology using a standard set of criteria. The criteria TEC uses are as follows:

1. The technology must have final approval from the appropriate governmental regulatory bodies.
2. The scientific evidence must permit conclusions concerning the effect of the technology on health outcomes.
3. The technology must improve the net health outcome.
4. The technology must be as beneficial as any established alternatives.
5. The improvement must be attainable outside the investigational settings.

In a March 1996 assessment, the Blue Cross Blue Shield Technology Evaluation Center found small bowel/liver combination transplants for adults and children as well as small bowel transplants alone for children to meet their criteria for coverage. Small bowel transplantation alone in adults did not meet their criteria. In July 1999, the Technology Evaluation Center conducted a further technology assessment of small bowel transplants in adults and multivisceral transplants in adults and children. Findings from the 1999 Technology Evaluation Center review are summarized as follows:

- The primary immunosuppressant agent for intestinal transplantation, tacrolimus, was approved by the Food and Drug Administration in April 1994 for rejection prophylaxis in liver transplantation. Thus, small bowel/liver and multivisceral transplantation is an approved use. Use of this drug for small bowel transplantation alone represents an off-label use of the drug.
- Data are available on several case series of patients undergoing intestinal transplantation. Reasonably reliable overall survival rates can be calculated by procedure; however, numbers are sufficiently small, therefore, TEC can only reliably calculate the overall survival for the total number of patients undergoing these procedures. The largest data sets analyze long-term survival of 41 adults receiving small bowel transplant alone and 30 patients receiving MVT.
- Long-term graft survival rates for adult patients undergoing small bowel transplants alone range from 13 - 30%. It is not possible to predict which patients will survive longer on TPN versus SB transplantation. Both treatments cause substantial morbidity in survivors; formal analysis of the quality of life between the treatments is not available.
- Whether small bowel transplantation in adults improves health outcomes has not been demonstrated in the investigational setting.
- Multivisceral transplantation in pediatric and adult patients has a similar 2-year survival at 33-50% at 5 years. Without this procedure, it is expected that these patients would face 100% mortality.
- The results of multivisceral transplantation are derived from specialized treatment settings, using desperately ill patients. Similar results can be expected only in specialized centers that have equivalent training, experience, and performance.

Based on the above, the Blue Cross Blue Shield Technology Evaluation Center found that small bowel transplantation in adults does not meet its criteria. However, multivisceral transplantation in adult and pediatric patients meets the criteria.

3. Center for Practice and Technology Assessment

We also requested the Center for Practice and Technology Assessment at the Agency for Healthcare Research and Quality (AHRQ) to perform an assessment of intestinal transplantation. AHRQ performed a computerized literature search and supplemented this with a review of the 11 studies submitted to HCFA by the requester and the TEC assessment described above. A total of 211 full-text articles were reviewed. Data include case series as well as reports from national and international registries. There are numerous methodological problems with the data, including the fact that individual patients appear to be represented in multiple published data sets. No controlled clinical trials were identified.

Transplantation data derive mainly from reports of patients who received transplantation after failing TPN. These patients would be expected to die without the transplantation. Reported survival rates for patients receiving intestinal transplantation range from 48% to 55% at 5 years. AHRQ could not identify studies of outcomes for patients on long-term TPN specifically for intestinal failure, or for patients with or without transplantation who are considered to be at "high risk" of TPN failure.

This assessment evaluated data on TPN from the registry of TPN in North America, Great Britain, Denmark and France, as well as a combined Belgian-French survey and a 1997 comprehensive systematic worldwide review of TPN experience. They found overall survival with TPN high (approximately 90% at 1-year and 60% 5-year survival). TPN-related deaths were approximately 10%. Complications of TPN are generally sepsis, vena cava thrombosis and hepatic failure.

A summary of the AHRQ findings is as follows:

1. The available data do not permit precise quantitative estimates of mortality rates for patients who are candidates for SBT either because of TPN failure or because of supposed high risk for TPN failure. Available data are not sufficient to determine the expected rates of other outcomes of interest.
2. In general, transplants have only been done on patients who have failed TPN. Based on available data, patient survival rates (adults and children) at 1, 3, and 5 years following SBT or related procedures range from 46% - 80%, 48% - 60%, and 48% - 55%, respectively.
3. Death is the expected outcome for patients failing TPN who do not receive a transplant.
4. Graft survival rates (adults and children at 1, 3, and 5 years following SBT or related procedures range from 50% -90%, 36%-48%, and 40%-48%, respectively.
5. Survival at 1, 3, and 5 years for the general group of patients on long-term TPN are reported to be approximately 90%, 65-80%, and 60% respectively.
6. Criteria for identifying patients at "high risk" for TPN failure are not defined. Specific outcomes for this group of patients cannot be determined.

The assessment concludes that small bowel and related transplantation appear to be potentially life-saving options for patients who have failed TPN and would therefore otherwise face certain death. The data are not sufficient to determine whether the risks and benefits of small bowel transplant and related procedures might yield a net benefit to patients who can continue TPN, but are considered at high risk to fail TPN sometime in the future. In order to make this determination, well-done studies that compare transplant with continue TPN would need to be conducted in patients who meet an agreed-upon definition of "high risk" for TPN failure.

The data are not sufficient to determine whether young patients, who are known to require TPN for the rest of their lives without chance of recovering intestinal function, should be provided the opportunity to receive a transplant prior to reaching the point of failing TPN.

4. Questions Posted on the Internet

Based on our review of the information discussed above, additional information was needed in order to develop a Medicare national coverage policy. We posted the following questions to our Internet site in an effort to solicit information that would assist us with the development of an appropriate policy.

- What clinical manifestations define "failed total parenteral nutrition (TPN)" and what literature is available to support this definition?
- Is there scientific evidence to support coverage of small bowel and multivisceral transplantation in the age 65 and older population?
- Scientific evidence considered in the assessment is based primarily on the experience in two hospitals. Is there evidence to expand Medicare coverage to this procedure in other facilities?
- Is there scientific evidence to support specific facility criteria (similar to Medicare coverage of liver, heart and lung transplants) that should be met prior to Medicare coverage of transplants in that facility?
- Is there scientific evidence to support small bowel and multivisceral transplantation in patients with malignant disease and if so, what types of malignant disorders?

In response to our web-site posting, we received one submission. The submission included 19 additional articles on small bowel transplantation and TPN. It also included the opinion of one of the most experienced surgeons in the field regarding the specific questions raised on the web site. Several of these subsequent articles were abstracts, unpublished reports, descriptions of surgical techniques and text materials (transplant symposium). Several articles focused on TPN. These items are discussed in more detail in the following section of this decision memorandum.

Medicare's Response to the National Coverage Request

There are three different types of intestinal transplantation: isolated intestinal transplant, combined liver-intestinal transplant and multivisceral transplant. In this section, we use the general term intestinal transplant to include all three types of transplant. While the literature reports small variations in the actuarial survival of patients receiving small bowel transplants due to differences in data used, number of organs transplanted, and methodologies, it is important to note that 1-year survival for all intestinal transplantation is approximately 70 percent. The surgical mortality of the procedure is high. For example, the Miami experience indicates that all their patient deaths from a 2-year study period occurred within the first 76 days.

In addition, the literature reveals that complications following surgery are common, including rejection, cytomeglovirus disease, lymphoproliferative disease and infection. For example, the rates for SBT, SB/LT, and MVT respectively reported by the intestinal registry are 79%, 71% and 56% for acute graft rejection, 13%, 3%, and 0% for chronic graft rejection, 24%, 18% and 40% for cytomegalovirus disease, and 7%, 11% and 13% for lymphoproliferative disease. The evidence consistently shows that there is a 50 percent or less chance of long-term (4 - 5 years) survival after intestinal transplantation. It is also questionable if the procedure enhances quality of life. That is, the literature on quality of life is not consistent. A study by Rovera et al.[6] found no difference in the quality of life between patients receiving intestinal transplantation and those on TPN, while a study by DiMartini et al.[7] found improvement. After transplantation, patients require lifelong immunosuppressive therapy.

The evidence on which to base a determination on Medicare coverage regarding intestinal transplantation is sparse. After reviewing two technology assessments and all of the studies contributed by the public, we have found no studies that permit us to directly compare the surgical procedure of intestinal transplantation to long-term TPN therapy for intestinal failure medically. (There are two studies that use subjective measures to compare the quality of life as perceived by the patients in the two treatment groups. One of these indicated no difference in quality of life between the treatment modalities; the other indicated improved quality of life for transplantation over TPN.) As the AHRQ assessment points out, we could not identify studies of outcomes on patients on long-term TPN specifically for intestinal failure or for patients who are considered to be at "high risk" of TPN failure. This is an infrequently performed procedure. In fact, the international registry indicates that there have only been 273 procedures performed worldwide as of 1997. Although incidence of intestinal transplantation have increased, as of this date, the Scientific Registry of transplant procedures indicates that there have been only 439 total intestinal transplants performed in this country.

It seems clear that the various forms of intestinal transplantation (i.e., SBT, SB/LT, and MVT) may offer an alternative life -saving therapy for restoring intestinal function in patients with irreversible intestinal failure. However, the procedure is undoubtedly one of high risk. Given that there is no comparative data to alternative therapy we believe that intestinal transplantation can only be considered as reasonable and necessary when it is a procedure of last resort. Intestinal transplantation should be reserved only for patients with life-threatening complications from TPN who are expected to die without the transplantation. Therefore, we are limiting Medicare coverage of intestinal transplantation only to patients who have failed TPN (as define below). Coverage will include intestinal transplantation alone (SB), combined liver-intestinal transplantation (SB/LT), and multivisceral transplantation (stomach, duodenum, pancreas, liver and intestine).

A. Definition of Failed TPN

As pointed out in the AHRQ assessment and the David Grant intestinal registry report, the clinical indications for intestinal transplantation supported by the literature are impending liver failure due to TPN, thrombosis of major central venous channels, frequent line infection and sepsis and severe dehydration. In response to our solicitation on the web, the University of Pittsburgh has offered increased detail to permit us to further define the clinical conditions that indicate failed TPN for liver failure, thrombosis, frequency of infection and dehydration. Thus, Medicare will cover intestinal transplantation only in the following clinical situations:

- Impending or overt liver failure due to TPN induced liver injury. The clinical manifestations include elevated serum bilirubin and/or liver enzymes, splenomegaly, thrombocytopenia, gastroesophageal varices, coagulopathy, stomal bleeding or hepatic fibrosis/cirrhosis.
- Thrombosis of the major central venous channels; jugular, subclavian, and femoral veins. Thrombosis of two or more of these vessels is considered a life threatening complication and failure of TPN therapy. The sequelae of central venous thrombosis are lack of access for TPN infusion, fatal sepsis due to infected thrombi, pulmonary embolism, superior vena cava syndrome, or chronic venous insufficiency.
- Frequent line infection and sepsis. The development of two or more episodes of systemic sepsis secondary to line infection per year that requires hospitalization indicates failure of TPN therapy. A single episode of line related fungemia, septic shock and/or Acute Respiratory Distress Syndrome are considered indicators of TPN failure.
- Frequent episodes of severe dehydration despite intravenous fluid supplement in addition to TPN. Under certain medical conditions such as secretory diarrhea and non-constructable gastrointestinal tract, the loss of the gastrointestinal and pancreatobiliary secretions exceeds the maximum intravenous infusion rates that can be tolerated by the cardiopulmonary system. Frequent episodes of dehydration are deleterious to all body organs particularly kidneys and central nervous system with the development of multiple kidney stones, renal failure, and permanent brain damage.

We received information also suggesting that significant bone disease, metabolic disorders, developmental insufficiency, and significant limitations on social and personal activities be considered as failed TPN. However, these are common side effects for patients on long-term TPN therapy. The literature we reviewed, including the AHRQ assessment and the intestinal transplant registry report, does not mention these conditions as indications for intestinal transplantation. Since they are not included in the literature and are common side effects of TPN, we do not consider these indications of therapy failure.

B. Contraindications

Rajendra and Pollard's article[8] states that the contraindications for small bowel transplantation include age over 60 years, cardiopulmonary insufficiency, presence of AIDS, systemic malignancy, and life-threatening infections. In response to the questions raised in the Internet posting, Dr. Abu-Elmagd, one of the most published researchers on the topic of intestinal transplantation, indicates, "There is no scientific evidence at the present time to support coverage of small bowel, combined liver-small bowel or multivisceral transplantation in the age 65 and older population." The literature is clear that all forms of intestinal transplantation are primarily pediatric procedures with two-third of the procedures occurring in children. Grant's analysis of data in the international registry of intestinal transplantation reports only 11 percent of these procedures were performed on patients over age 40. Further, the outcomes for intestinal transplantation in patients between the ages of 2 and 18 are superior to that in adult patients. In an informal query of the data maintained by the Scientific Registry of Transplant Recipients, we learned that there have been nine transplants of patients over 60 with a maximum age of 66; only five of these resulted in functioning grafts.

We believe the evidence supports the fact that aged patients generally do not survive as well as younger patients receiving intestinal transplantation. Nonetheless, some older patients who are free from other contraindications have received the procedure and are progressing well, as evidenced by the UNOS data. Thus, we do not believe it is appropriate to include specific exclusions from coverage, such as an age limitation, in the national coverage policy. We note that the facility criteria described below include an outcome measure. This outcome measure will serve to exclude facilities that fail to consider individual patient contraindications in selecting patients for the procedure.

C. Facility Criteria

As noted in the background section of this document, Medicare has historically limited organ transplantation to centers that meet specific criteria. The current criteria for heart, liver and lung transplantation consider medical criteria, (such as patient selection policies, patient management protocols, and evaluation of the transplant team), experience criteria (such as volume and outcome measures), and administrative criteria (such as laboratory services, organ procurement organizations, maintenance of data, and appropriate billing). Because of the high risk associated with intestinal transplantation, we believe coverage of this procedure should similarly be limited to carefully selected centers with demonstrated success.

There is scientific evidence that links annual volume levels of other types of high risk surgical procedures to successful outcomes. For example, a 1994 Journal of American Medical Association article by Hosenpud et al [9]and a 1999 New England Journal of Medicine article by Edwards et al[10] discuss the effect of volume on heart and liver transplantation respectively. These articles indicate significant difference in likelihood of survival in high volume centers. For heart transplantation, the Hosenpud article found risk of 1-year mortality increased 33 percent in heart transplant centers performing fewer than nine cardiac transplants per year. Edwards et al similarly found the 1-year mortality rate for centers performing fewer than 20 liver transplants per year (or lack of affiliation with a high volume center) increased eight percentage points (28.3 percent mortality for high volume compared to 20.1 percent for low volume).

The research conducted by David Grant on the intestinal transplantation registry demonstrated that transplant volume greater than 10 is a significant variable in predicting positive health outcomes of the procedure. This, coupled with the literature on volume and outcomes applicable to other organ transplants, results in a determination to limit Medicare coverage of intestinal transplantation to centers that perform 10 or more transplants per year. At this time, we know of three centers that provide intestinal transplantations at this volume.

The 1997 report of the International Intestine Transplant Registry, which includes data from 33 transplant programs, reports on the outcomes of 273 procedures. The 1-year patient survival for procedures done after February 1995 was 69 percent for SBT, 66 percent for SB/LT, and 63 percent for MVT. Since the volume of individual types of procedures for a specific center would be so small as to be statistically meaningless, we believe centers should report aggregate survival. Thus, we are establishing the 1-year survival criterion for Medicare approval of centers for intestinal transplantation at 65 percent.

In summary, Medicare will cover intestinal transplantation for the purpose of restoring intestinal function in patients with irreversible intestinal failure only when performed for patients who have failed TPN and only when performed in centers that meet approval criteria. The criteria for approval of centers will be based on an annual volume of 10 intestinal transplants per year with a 1-year actuarial survival of 65 percent.

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[1] Handelsman H, Zarin D. Small bowel transplantation: AHRQ technology assessment. April 2000. Unpublished.

[2] Grant D, Intestinal transplantation: 1997 report of the international registry. Transplantation. 1999; 67(7): 1061-1064.

[3] Abu-Elmagd KM, Reyes J, Todo S, et al. Clinical intestinal transplantation: new perspectives and immunologic considerations. Journal of American College of Surgeons. 1998; 186(5): 512-527.

[4] Karatzas T, Khan F, Tzakis AG. Clinical intestinal transplantation: experience in Miami. Transplantation Proceedings. 1997; 29:1787-1789.

[5] Grant D. Intestinal transplantation: 1997 report on the international registry. 1999; 67(7):1061-1064.

[6] Rovera GM, DiMartini A, Schoen RE, Rakela J, Abu-Elmagd K, Graham TO. Quality of life of patients after intestinal transplantation. Transplantation. 1998; 66(9) 1141-1145.

[7] DiMartini A, Rovera GM, Graham TO, et al. Quality of life after intestinal transplantaton and among home parenteral nutrition patients. Jurnal of Parenteral and Enteral Nutrition. 1999; 22(6) 357-362.

[8] Rajendra PK, Pollard SG. Small bowel transplantation. Current Opinions in Gastroenterology. 2000. 16(2) 126-133.

[9] Hosenpud JD, Breen TJ, Edwards EB, Dailey OP, Hunsicker LG. The effect of transplant center volume on cardiac transplant outcome: a report of the United Network for Organ Sharing Scientific Registry. Journal of the American Medical Association. 1994; 271(23): 1844-1849.

[10] Edwards EB, Roberts JP, McBride MA, et al. The effect of the volume of procedures at transplantation centers on mortality after liver transplantation. New England Journal of Medicine. 1999; 341(27):2049-2053.

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Bibliography

Articles Submitted
University of Pittsburgh

Abu-Elmagd K, Reyes J, Todo S, et al.. Clinical intestinal transplantation: new perspectives and immunologic considerations. American College of Surgeons 1998; 186(5):512-527.

Abu-Elmagd KM, Reyes J, Fung JJ. Clinical intestinal transplantation: recent advances and future considerations. AST Primer on Transplantation ; :.

Abu-Elmagd KM, Reyes JD, Mazariegos GV, et al. Intestinal transplantation. 2000; :, abstr.

Abu-Elmagd, K.. Proposal - medicare coverage of intestinal transplantation (request for formal review). 1999; :1-14.

Abu-Elmagd, K.M., Reyes, J., Fung, J.J., et al. Evolution of clinical intestinal transplantation: improved outcome and cost effectiveness. Transplantation Proceedings 1999; 31:582-584.

Bertinet DB, Tinivella M, Balzola FA, et al. Brain manganese deposition and blood levels in patient undergoing home parenteral nutrition. Journal of Parenteral and Enteral Nutrition 2000; 24(4):223-227.

Burnes JU, O'Keefe SJ, Fleming R, et al. Home parenteral nutrition - a 3-year analysis of clinical and laboratory monitoring. Journal of Parenteral and Enteral Nutrition 1992; 16(4):327-332.

Cavicchi M, Beau P, Crenn P, Degott C, Messing B. Prevalence of liver disease and contributing factors in patients receiving home parenteral nutrition for permanent intestinal failure. Annals of Internal Medicine 2000; 132(7):525-532.

Chatzipetrou MA, Tzakis AG, Pinna AD, et al. Intestinal transplantation for the treatment of desmoid tumors associated with familial adenomatous polposis. Unpublished ; :.

Deltz E, Schroeder P, Gebhardt H, etal.. Successful clinical small bowel transplantation: Report of a case. Clinical Transplantation 1989; 3:89-91.

DiMartini A, Rovera GM, Graham TO, et al. Quality of life after small intestinal transplantation and among home parenteral nutrition patients. Journal of Parenteral and Enteral Nutrition 1999; 22(6):357 - 362.

Farmer DG, McDiarmid SV, Yersiz H, et al. Improved outcome after intestinal transplantation: an 8-year, single center experience. unpublished ; :.

Furukawa H, Reyes J, Abu-Elmagd K, et al.. Intestinal transplantation at the University of Pittsburgh: six-year experience. Transplantation Proceedings 1997;

Grant D. Intestinal transplantation: 1997 report of the international registry. Transplantation 1999; 67(7):1061-1064.

Grant D, Wall W, Mimeault R, et al.. Successful small-bowel/liver transplantation. Lancet 1990; 335:181-184.

Howard L, Ament M, Fleming CR, Skike M, Steiger E. Current use and clinical outcome of home parenteral and enteral nutrition therapies in the United States. Gastroenterology 1995; 109(2):355-365.

Howard L, Hassan N. Home parenteral nutrition: 25 years later. Clinical Nutrition 1998; 27(2):481-512.

Idoate MA, Martinez AJ, Bueno J, Abu-Elmagd K, Reyes, J. The neuropathology of intestinal failure and small bowel transplantation. Acta Neuropathology 1999; 97:502-508.

Karatzas T, Khan F, Tzakis AG. Clinical intestinal transplantation : experience in Miami. Transplantation Proceedings 1997; 29:1787-1789.

Langnas AN. VI internation small bowel transplant symposium. Program syllabus 1999; :.

Langnas AN, Dhawan A, Antonson DL, et al.. Intestinal transplantation in children. Transplantation Proceedings 1996; 28(5):2752.

Langnas AN, Shaw BW, Antonson DL, et al.. Preliminary experience with intestinal transplantation in infants and children. Pediatrics 1996;

Misra S, Kirby DF. Micronutrient and trace element monitoirng in adult nutrition support. Nutrition in Clinical Practice 2000; 15:120-126.

Niv, Y., Mor, E., Tzakis, A.. Small bowel transplantation - a clinical review. The American Journal of Gastroenterology 1999; 94(11):3126-3130.

no author listed. Intestinal transplant registry. 1999; :.

O'Keefe SJ, Peterson ME, Fleming CR. Octreotide as an adjunct to home parenteral nutrition in the management of permanent end-jejunostomy syndrome. Journal of Parenteral and Enteral Nutrition 1994; 18(1):26-34.

Reyes J, Todo S, Bueno J, et al.. Intestinal transplantation in children: five-year experience. Transplantation Proceedings 1996; 28(5):2755-2756.

Rovera GM, DiMartini A, Schoen RE, etal. Quality of life of patients after intestinal transplantation. Transplantation 1998; 66(9):1141-1145.

Seidner DL, Licata A. Parenteral nutrition-associated metabolic bone disease: pathophysiology, evaluation, and treatment. Nutrition in Clinical Practice 2000; 15(4):163-170.

Starzl T, Rowe MI, Todo S, et al.. Transplantation of Multiple Abdominal Viscera. Journal of the American Medical Association 1989; 261(10):1449-1457.

Thompson JS, Langnas AN, Pinch LW et al. Surgical approach to short-bowel syndrome. Annals of Surgery 1995; 222(4):600-607.

Todo S, Reyes J, Hiroyuki F, et al.. Outcome analysis of 71 clinical intestinal transplantations. Annals of Surgery 1995; 222(3):270-282.

Todo S, Tzakis A, Abu-Elmagd K, Reyes J, Starzl TE. Current status of intestinal transplantaton. Advances in Surgery 1994; 27:295-316.

Articles Submitted
HFCA

Blue Cross Blue Shield Technology Evaluation Center. Small bowel transplants in adults and multivisceral transplants in adults and children. Assessment Program 1999; 14(9):1-17.

Handelsman H, Zarin D. Small Bowel Transplantation. Center for Practice and Technology Assessment 2000; :.

Rajendra PK, Pollard, SG. Small bowel transplantation. Current Opinions in Gastroenterology 2000; 16(2):126-133.

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